EVALUATION OF FIBERS USED IN FISHING LINES

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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ABSTRACT

This project is about the experiments conducted to prove that most of the commercial fishing lines exhibited a higher breaking strength than the actual breaking strength. Besides, this project also about the investigation of the reason why fishing line that has been used can not stand for prolonged of time. So this experiment is done by stretching a test of various types and brand names of fishing lines that have in the market nowadays and subsequently to discuss and make conclusions on issues that related to the results obtained from the study. Experiments are carried out according to Malaysian Standard that was prepared by the Technical Committee on Yarns, Threads and Twines under the authority of the Textile and Clothing Industry Standards Committee. It is based on The International Standard ISO 2062 'Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)' with reference being made to the British Standard BS 1932 : Part 1 : 1965 'Methods of testing the strength of yarns form packages - Part 1 : Determination of breaking load and extension'. This project has three objectives that must achieve. The first objective is to design a suitable of tensile test rig for fishing line and has prescribed standard test method for tensile properties of fiber that used in fishing lines. The second objective is to identify the mechanical properties of fishing lines. Lastly, the third objective was to investigate the effect of environmental exposure that subjected to freshwater, seawater or salt water and natural environment expose. Based on the result of from the experiments, it is found that the specimens that were exposed to freshwater, saltwater and the natural environmental give effect to the degradation of strength of fishing line. It means that water and uv light are the factors that cause the strength of fishing lines become lower. That is the reason why fishing line that has been used can not stand for prolonged of time.

ABSTRAK

Projek ini adalah berkaitan eksperimen-eksperimen yang dijalankan untuk membuktikan bahawa kebanyakan tali tangsi yang dijual di pasaran mempamerkan kekuatan putus yang lebih tinggi daripada kekuatan putus yang sebenar. Selain itu, projek ini juga adalah untuk menyiasat apakah sebab yang menyebabkan kekuatan tali tangsi yang telah digunakan boleh merosot. Jadi kajian ini dilakukan dengan membuat ujian keregangan terhadap pelbagai jenis dan jenama tali tangsi yang ada di pasaran dan seterusnya dapat membincangkan dan membuat kesimpulan terhadap masalah yang berkaitan berdasarkan keputusan yang diperoleh daripada hasil kajian. Eksperimen-eksperimen yang dijalankan adalah mengikut Malaysian Standard yang disediakan oleh "Technical Committee on Yarns, Threads and Twines" di bawah kuasa "Textile and Clothing Industry Standards Committee". Eksperimen ini merujuk kepada "The International Standard ISO 2062 'Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)' yang berpandukan dengan "British Standard BS 1932 : Part 1 : 1965 'Methods of testing the strength of yarns form packages - Part 1 : Determination of breaking load and extension". Kajian ini mempunyai tiga objektif. Objektif pertama adalah mereka bentuk satu komponen mesin yang sesuai dan mengikut piawaian kaedah kajian yang ditetapkan untuk mengkaji kekuatan regangan tali tangsi. Objektif yang kedua adalah mengenalpasti ciri-ciri mekanikal bagi tali tangsi. Objektif yang ketiga adalah menyiasat pengaruh pendedahan persekitaran seperti air bersih, air laut atau air garam dan persekitaran sekeliling terhadap tali tangsi. Berdasarkan keputusan yang diperoleh daripada eksperimen yang telah dijalankan, didapati terbukti bahawa kekuatan tali tangsi yang dijual di pasaran adalah lebih tinggi daripada kekuatan sebenarnya. Selain itu, didapati bahawa tali tangsi yang telah terdedah kepada air bersih mahupun air garam serta terdedah kepada persekitaraan sekeliling telah mengalami kemerosotan kekuatannya. Ini bermakna bahawa air dan sinaran uv adalah factor yang menyebabkan kekuatan tali tangsi merosot. Ini juga adalah sebabnya tali tangsi yang pernah digunakan tidak dapat bertahan lama.

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CRE	Constant-rate-of-specimen-extension
CRL	Constant-rate-of-loading
CRT	Constant-rate-of-transverse
Eq.	Equation
ISO	International Organization for Standardization
PA	Polyamide
PE	Polyethylene
PVDF	Polyvinylidene fluoride
SIRIM	Standards and Industrial Research Institute of Malaysia
UTS	Ultimate tensile strength
UV	ultra violet
Vs.	versus

CHAPTER 1

INTRODUCTION

1.1 Project Background

Fibers defined as a class of material whose length is much greater than its cross-sectional dimensions. According to the length, fibers are continuous filaments or are in discrete elongated pieces which are similar to lengths of thread. Fibers are often used in the manufacture of other materials. Fishing lines is made from some classes of fiber based on synthetic polymers such as nylon, polyethylene and fluorocarbon. Thus, this project is about the experiments conducted to prove that most of the commercial fishing lines exhibited a higher breaking strength than the actual breaking strength. Often, users will be confused and disappointed because they always fail in the 'battle' with their catch because the used line broke even though they used the stronger and expensive line. So this experiment is done by stretching a test of various types and brands of fishing lines that have in the market nowadays and subsequently to discuss and make conclusions on issues that related to the results obtained from the study. Experiments are carried out according to Malaysian Standard that was based on The International Standard ISO 2062 ‘Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)’.

1.2 Problem Statement

i. Commercial retail fishing line of stated pound-test is higher than the actual pound-test. Often, users will be confused and disappointed because the line that they used always broke even though they used the stronger and expensive line.
ii. Fishing line users are confused why they can not use the same line in prolonged of time. The experiments must be done to investigate the factors that effect the degradation of fishing lines.

1.3 Project Objectives

i. Estimate the mechanical properties of fishing lines.
ii. Investigate the influence of water and uv light to fishing line degradation.
iii. Design and fabricate tensile test rig for fishing line testing.

1.4 Project Scopes

i. The experiments tests were performed in accordance with the ISO 2062 ' Methods For The Determination Of Breaking Load Of Yarns From Packages – CRL, CRE and CRT Testers'
ii. Types of fishing lines that being tested are nylon, polyethylene, and fluorocarbon lines.
iii. The brand name of fishing lines that being tested are Fisherman, Berkley, Exory, I-Fish, Seahawk, Conato, Tomman, Abu Garcia, Nelayan, Daiwa, Triple Fish, P-Line, Seaguar, Stren, Otoro, Besd Internasional, Cortland Master, Power Pro Spectra, Ajiking and Ohero.
iv. Fishing lines that being tested are subjected to freshwater, salt water, and natural environmental exposure.

1.5 Project Flow Chart

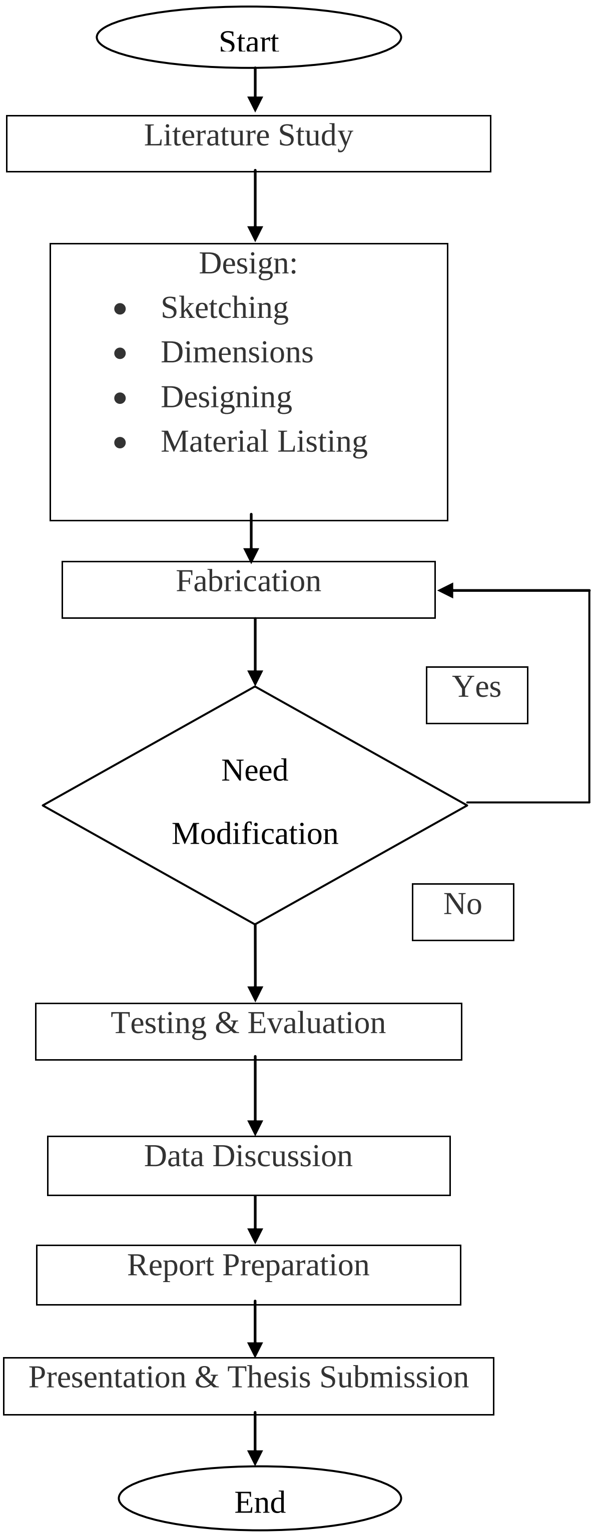

Figure 1.1: Project Flow Chart

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Fishing lines is made from some classes of fiber based on synthetic polymers such as nylon, polyethylene and fluorocarbon. Tensile test is a common and important test that provides a variety of information about the fibers used in fishing lines that being tested, including the elongation, yield point, modulus of elasticity, toughness, tensile strength, and ultimate strength of the material. This project is focus on doing the tensile test for the fishing line specimens. The experiments must carried out according to Malaysian Standard that was based on The International Standard ISO 2062 'Textiles - Yarn from packages - Method for determination of breaking load and elongation at the breaking load of single strands - (CRL, CRE and CRT testers)'. Furthermore, the appropriate of tensile test rig must be choosing to avoid the premature specimen failure.

2.2 Testing Standard

2.2.1 ISO 2062 'Method For Determination Of Breaking Load And Elongation At The Breaking Load Of Single Strands-(CRL, CRE And CRT Testers)'.

This testing standard had been approved by the Textile and Clothing Industry Standards Committee and endorsed by the Council of the Standards and Industrial Research Institute of Malaysia (SIRIM) and was published under the authority of the SIRIM Council in September, 1976.

The method authorizes the use of three typed of testing machines in common use for measuring the breaking load and elongation at the breaking loads of yarns. The types of machines are:

a) Constant-rate-of-load (CRL). This method is run by subjected the specimen to an increasing load at a predetermined constant rate such that the average time-to-break will fall within the specified limits.

b) Constant-rate-of-specimen-extension (CRE). This method is run by elongating the specimen at a predetermined constant rate such that the average time to reach the breaking elongation will fall within the specified limits.

c) Constant-rate-of-traverse of the driver clamp (CRT), with pendulum or spring weighing mechanism. This method is run by subjected the specimen to an increasing load by traversing the driven clamp at a constant rate such that the average time-to-break will fall within the specified limits.

2.2.2 Scope

This International Standard specified a method for the determination of the breaking load & breaking elongation of various types of yarn is design primarily for yarn in package form but can also be used for single strands extracted from a fabric.

So, this method is applicable to single yarns of several types of fishing lines which are monofilament and multifilament lines.

Optional procedures for determining the breaking load are included Option 1 that covers test based on specimens in equilibrium with the standard atmosphere for testing and Option 2 that covers tests based on specimens in wet state.

This project is run by follow the optional experiment procedures of Option 1A which is constant-rate-of-specimen-extension (CRE). Based on this method, the fishing line that is being tested is elongated at a constant rate such that the average time to reach the breaking elongation will fall within the specified limits.

The experiment procedures of Option 2 also being follow to run the experiments for determination of the breaking load of fishing lines that are subjected to freshwater, salt water and the natural environmental exposure.

2.2.3 Mechanical Properties

a) Stress & Strain

i. The tensile stress on a material is defined as the force per unit area as the material is stretched. The cross-sectional area may change if the material deforms as it is stretched, so the area used in the calculation is the original undeformed cross-sectional area A_o as shown in Eq. 2.1.

$$\sigma = \frac{Force}{\mathrm{Ao}} \tag{2.1}$$

The units of stress are the same as those of pressure. In the polymer literature, stress often is expressed in terms of psi (pounds per square inch).

ii. The strain is a measure of the change in length of the sample. The strain commonly is expressed in one of two ways as shown in Eq. 2.2 and Eq. 2.3.

Elongation:
$$\delta = \frac{\Delta L}{L\circ} \tag{2.2}$$

Extension ratio:
$$\varepsilon = \ln\left(\frac{Li}{Lo}\right) \tag{2.3}$$

b) Ultimate Tensile Strength

One of the properties you can determine about a material is its ultimate tensile strength (UTS). This is the maximum load the specimen sustains during the test as shown in Figure 2.1. The UTS may or may not equate to the strength at break. This all depends on what type of material you are testing whether brittle, ductile, or a substance that even exhibits both properties. And sometimes a material may be ductile when tested in a lab, but, when placed in service and exposed to extreme cold temperatures; it may transition to brittle behavior.

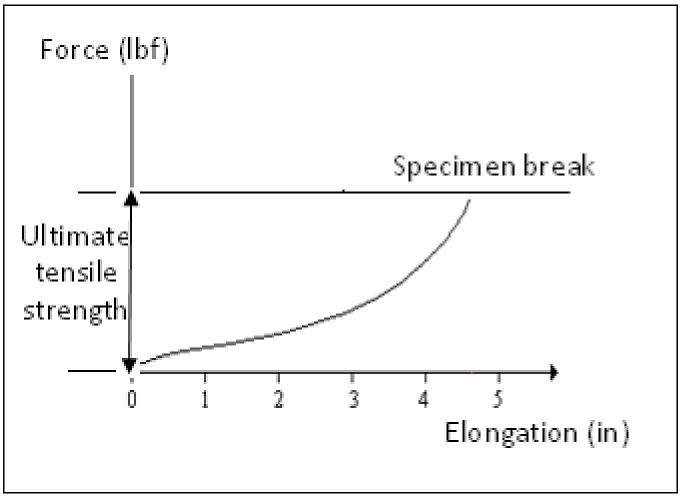

Figure 2.1: Ultimate Tensile Strength

c) Ultimate Elongation

The elongation-to-break is the strain on a sample when it breaks as shown in Figure 2.2. This usually is expressed as a percent. The elongation-to-break sometimes is called the ultimate elongation.

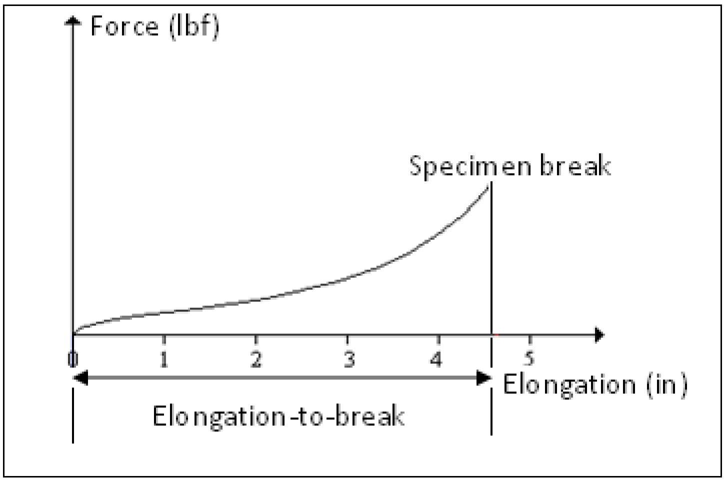

Figure 2.2: Ultimate Elongation

2.3 Tensile Test Specimen

2.3.1 Universal Testing Machine

Universal testing machines are most commonly used for static testing in a tensile or compression mode within a single frame as shown in Figure 2.3. They are also referred to as pull testers. Capacities for these systems range from low-load forces of 112 lbf (0.5 kN) up to high-capacity 135,000 lbf (600kN) test frames. These systems are frequently configured for automated testing.

Figure 2.3: Universal Testing Machine

Source: http://www.instron.us

2.3.2 Tensile Test Rig

The appropriate of tensile test rig must be choosing to avoid the premature specimen failure. There are a variety of grips that are appropriate for single strand fibers such as a) O-Ring Fiber Clamping Grips and b) Cord and Yarn Style Grips.

a) O-Ring Fiber Clamping Grips is designed to hold very small diameter fiber specimens during tension testing. Special considerations are built into the design, where the U-shaped bend provides sufficient area for specimen loading as shown in Figure 2.4.

Figure 2.4: O-Ring Fiber Clamping Grips

Source: http://www.instron.us

b) Pneumatic cord and yarn grips as shown in Figure 2.5 are provide a convenient method for clamping fiber, cord, yarns and fine braided wires to reduce the problem of jaw breaks associated with testing these materials.

A specially designed horn with a smooth finish and a contoured surface with a graduated cam allow for easy loading and a stress reduced clamping area on the specimen. The clamping mechanism can be activated either automatically or through a foot switch. This allows hands-free grip operation enabling the specimen to be held with both hands, for easy loading. Pneumatic cord and yarn grips provide selectable clamping force to accommodate different materials and excellent follow-up action which compensates for decay of the holding force due to specimen creep.

Figure 2.5: Pneumatic Cord and Yarn Style Grips

Source: http://www.instron.us

2.4 Type of Fishing Lines

2.4.1 Monofilament Line (Polyamide nylon)

Fishing line generally made from synthetic fibers that come from synthetic materials such as petrochemicals. Synthetic fibers account for about half of all fiber usage, with applications in every field of fiber and textile technology. Polymer fibers are a subset of synthetic fibers, which are based on synthetic chemicals (often from petrochemical sources) rather than arising from natural materials by a purely physical process. The classes of fiber based on synthetic polymers have been evaluated as potentially valuable commercial fishing line products are Polyamide (PA) nylon, Polyethylene (PE), eventually with extremely long chains (e.g. Dyneema or Spectra), and Polyvinylidene Fluoride (PVDF).

Monofilament is popular as a line material because of its low memory and suppleness, which make it easy to cast and handle. Most fishing line is made from monofilament because of its strength, availability in all pound-test kinds, and low cost. It also comes in many different colors such as white, green, blue, clear, and fluorescent. Monofilament is made by melting and mixing polymers and then extruding through tiny holes, forming strands of line, which is then spun into spools of various thicknesses. The extrusion process controls not only the thickness of the line but also the pound test of the line.

Monofilament is not advisable for deepwater fishing since it can absorb water resulting in loose knots, and its sensitivity can decrease when it is wet. Monofilament degrades with time and can weaken when exposed to heat and sunlight. When stored on a spool for a long time, it may come off the fishing reel in coils or loops. It is advisable to change monofilament line at regular intervals to prevent degradation. The example of monofilament line is shown in Figure 2.6.

Figure 2.6: Monofilament line

2.4.2 Braided Line (Polyethylene)

Braided line was one of the of earliest types of fishing line, and in its modern incarnations it is still very popular in some situations because of its high knot strength, lack of stretch, and great overall power in relation to its diameter. Braids were originally made from natural fibers such as cotton and linen, but natural fiber braids (with the very rare exception of braided silk) have long since been replaced by braided or woven fibers of a man-made materials like Dacron, Spectra or Dyneema into a strand of line. Braided fishing lines tend to have good resistance to abrasion. Their actual breaking strength will commonly well exceed their pound-test rating.

One drawback of braided lines is that they are generally opaque in the water, and thus visible to fish. Hence, it is common to attach a monofilament at the end of the braided fishing line to serve as a leader and to reduce the high visibility of the braided fishing line.

This type of fishing line is expensive; sometimes four times the cost of equivalent monofilament. This can become a considerable expense, especially considering that the line is so thin that you need more of it to fill a reel spool. Sometimes, a backing of monofilament or other line is used under the braided line on the spool. The example of braided line is shown in Figure 2.7.